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*ROAD ADMINISTRATION AND CONSTRUCTION

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Road-building and romance, one would suppose, are as far apart as the poles. To the great majority of us, the subject of roads is a very prosaic one indeed. What of interest can there possibly be in an occupation that centres around that most commonplace object —the country road.

With thoughts only of the country road, as we too often know it in Canada, in an undescribable condition of mud, dust, or roughness, according to the season, an attitude of mental indifference is no doubt justifiable.

And yet, if we could, by some magic gift, transform all the roads of Canada from their present condition to a state equal to the roads of England, or Scotland, or France, of what more desirable change for our material welfare, comfort, and happiness, can we conceive?

When we compare Canada with the advanced countries of the Old World, the unfavorable distinctions are not in the character of the people, nor in the wealth of the soil, nor in the beauty of landscape—but above all in the condition of the roads. No country ever looked well when viewed from a road axle-deep in mud.

And so, having before us the ideal of Canada, reached in every part, and transformed by a completed system of good roads, the picture becomes one of absorbing interest and its every detail gathers around it as we go on, something of the romance that pertains to the finished work.

It is desirable that every worker, and particularly the engineer, should keep before him, the full perspective of the field in which he is engaged, in order that his efforts may be turned from ways that are too narrow. The work of constructing and maintaining 250,000 miles of existing country roads in Canada (50,000 miles in Ontario alone) to an adequate standard, is an end that may well inspire us.

Invention and Communication

The present era is remarkable as one of rapid and convenient travel, transportation and communication. In this it is distinguished

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from all preceding ages. Invention has shown more marked advance in this phase of modern civilization than in any other. Every refinement has been sought, and vast expenditures have been made on steam and electric railways, ocean and lake steamship lines, harbors and canals, express, postal, telephone, telegraph and cable services. The motor vehicle is becoming a necessity for the transaction of business and even the air has been conquered as a practical medium for human locomotion. All these have not lessened, but rather have increased the need for better common roads, and the demand for their improvement is accumulating with marked intensity.

Changed Traffic Conditions

Until the last ten or fifteen years, road construction in the open country was well served by waterbound stone and gravel, and was governed by established practice. Roads were built for horse-drawn traffic only, and the weight of loads was comparatively light. With the general use of rapid motor vehicles an entirely new form of wear has been added to that of steel tires and steel-shod horses; the weight of loads has largely increased, placing a much greater demand on road foundations and on bridges; the use of roads has greatly in creased, especially on highways carrying suburban and interurban traffic. Road building is in a reformative stage, and the annual accumulation of experience is steadily shedding new light on a very complex problem.

The road situation of to-day presents many problems. It is doubtful if road conditions will ever be without their problems, for changes are constantly taking place, requiring an equivalent adjustment in methods of dealing with them. But it is also true that the present generation has opportunity to advance in this regard far beyond reasonable heritage or desires—for in general common road construction has been neglected, has been side-tracked and forgotten in the hurry of railroad construction.

New demands are pressing; advanced methods of construction are needed; old systems of organization are inadequate; old abuses and prejudices are persistent; opportunity for reform and progress is abundant and urgent.

Increasing Usefulness of Roads

The growing difficulties of road construction and maintenance are not without their reward. The increased *use* of the roads means their increased *usefulness*. The possible service that may be performed by the common road is in proportion to the efficiency of the vehicle. The motor passenger vehicle and the motor truck have greatly advanced the general public value of the common road; and whereas good roads were regarded, a few years ago, as solely of rural concern, urban centres have become keenly alive to their value, and are willing to bear a fair proportion of the cost. The value of roads as a means of travel and transportation has increased many fold. Instead of the farming population being exp[illegible]ted as in

the past, to meet the entire cost, it is now fully conceded that, as regards main roads, cities must share the *burden as with any other* department of transportation of the future.

Ontario Road Policy

The Province of Ontario for over sixteen years, has been carrying on an aggressive road policy of education in road matters. In the beginning, the object was an educational one. Statistics had shown that the townships of the province were annually spending on their roads, about $1,400,000 in cash, and over 1,100,000 days of labor, with very unsatisfactory results. It was felt that, by a process of education, much could be done to make this annual outlay, valued at $2,500,000, of much more benefit in road improvement.

The result has been largely accomplished, and in matters of grading, drainage, and bridge construction, there has been much good derived from the educational work. The control of all roads, however, was still in the hands of township councils, and the entire cost was being borne by the rural districts, or about half the population. There was no classification, no sub-division for purposes of construction and finance, such as has been found essential in the development of adequate systems of public highways.

County Roads

In 1901, a more advanced step was taken when a plan of provincial (or state) aid was created. Under this scheme each County Council was empowered to take over, from the township authorities within the county, for construction and maintenance, a system of main, or market roads. The county, as a separate corporation, assumed full ownership and control of these roads. Unlike many systems of state aid, the County System is not a plan of disconnected patches designated from year to year, but must be fully mapped out at the inception, so as to secure proper connection as far as possible, throughout the county as a unit.

To the work of constructing these county systems, for the most part gravel and water-bound macadam roads, the province grants annually one-third of the expenditure. About $1,000,000 is now being spent annually on this work, by the Government and County municipalities.

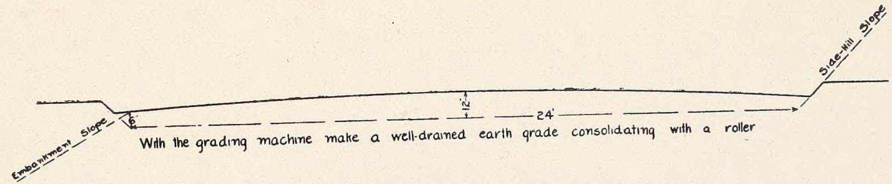
Commission Proposals

It has become apparent, however, that a still more advanced policy is necessary, and last year the Government of the province appointed a commission to go fully into the matter and make such recommendations as they thought advisable.

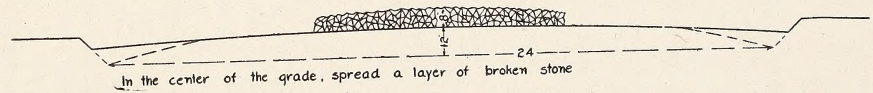
The report of the commission points out the value of good main roads to cities; showing that cities are largely benefitted; and that they should share in the cost. It is also proposed that motorists and railway corporations should contribute to the expense. From these sources the rural districts will be relieved from their present heavy charges for market and main roads.

MAKING A STONE ROAD—FIVE STAGES

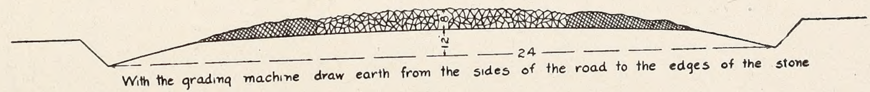
1. If a roller is not used make the crown higher to provide for settlement.



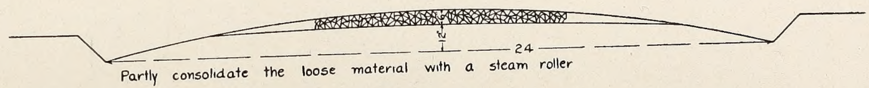
2. The dotted lines show the earth to be drawn in with the grading machine to hold the stone in place.



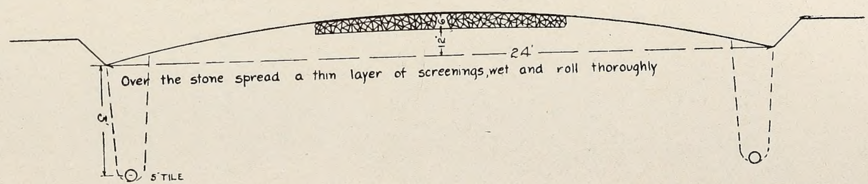
3. The gutters have been deepened by drawing the earth to the edges of the stone.



4. When partly consolidated less screenings are needed.



5. The complete road; care should be taken not to use too much screenings; and the open drains should be deepened as required. Tile are needed in wet soils only.



The above cross-sections show five stages in the construction of a single track road, built in the simplest possible way, suitable for the great majority of farm roads in Ontario. Open drains should have greater capacity in most cases to carry away freshets.

Roads are broadly classified as main, county and township. County roads are expected to include the chief market roads of each locality.

The Government contribution for county roads is to be increased to 40 per cent. Cities will be required to contribute to the upkeep of adjacent roads of a "suburban" class; while the province, out of part of the revenue from the motor vehicle fund, will give special assistance to the construction of heavily travelled main or "inter-urban" roads, so that the townships through which such roads pass, will not have to carry a burdensome charge for traffic originating outside of their boundaries.

Aid for maintenance will be given, in the same proportion as for construction, viz.: 40 per cent. It is regarded as a wasteful and useless expenditure to build good roads and thereafter neglect to keep them in repair. For this reason the resources of the province are drawn upon, in order that a good standard of maintenance may be reached.

Township roads are also regarded as deserving of special attention, in order that not merely a few market roads may be brought to a high standard; but that all may be raised to a standard suited to the traffic over them and that every farmer will reap the benefit. To this end, instead of a large grant to county roads alone, a grant of 20 per cent is to be made for township road improvement.

Special grants are to be made to villages having a large area and small population; while townships having an excessive number of bridges will be given Government aid so as to more nearly equalize the burden.

A plan of short term loans, without interest, to townships, is recommended. This is similar to the method followed in England, and it is anticipated, will enable municipalities and progressive communities to finance such substantial work as they may desire with economy, and under a system of easy payments.

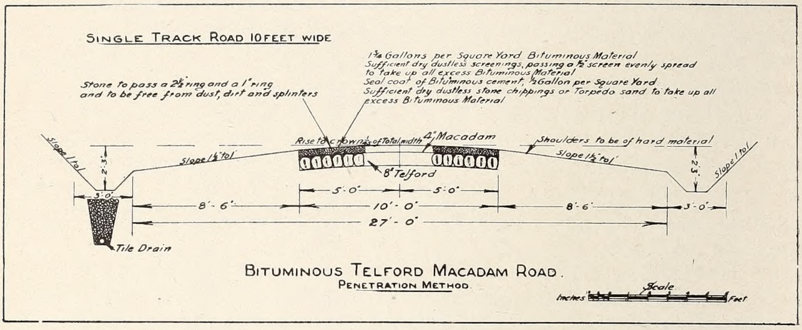
With 50,000 miles of rural roads in Old Ontario, it is anticipated that 7,500 miles will be constructed as first-class main or market roads, and that the remaining 42,500 miles will be brought to a fair standard, as good gravel roads or well-drained earth roads. On construction, a total expenditure of $30,000,000 is proposed, for work extending over a period of 15 years. Of this it is estimated that the province will pay $12,000,000; cities $6,000,000; and the counties $12,000,000. In addition to its share of construction, the province will also pay 40 per cent of the cost of maintaining market (or county) roads.

Under such a plan of encouragement to road construction, it is believed that the system proposed for Ontario will prove a decided advantage, and will create a type of road fully adequate to the needs of the province.

And that there will gradually be developed a system of main roads joining the chief cities of the province; that good systems of market roads for farm traffic will be built up; and that the more local feeders will be improved so as to meet the needs of traffic over them.

Municipal Authority

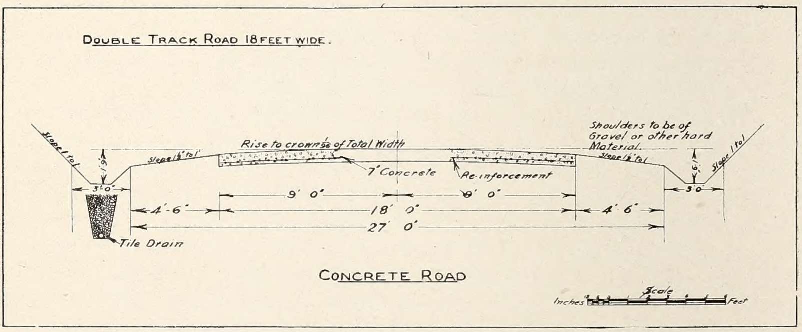
Local self-government through mun cipal organization is in the highest degree desirable in nurturing an intelligent, progressive, self-reliant people. A lively interest in their local affairs of roads, drainage, education, creates a sense of responsibility and a knowledge of government, that shows itself in the home life and in the



Bituminous Telford Macadam Road.
Penetration Method

higher statesmanship of a people. It is my personal observation under many conditions, on this continent and in Europe, that the fullest responsibility for local self-government meets a ready response from all the best citizenship, and its reward in the greater dignity of the individual and of the nation.

A central government of province or nation, therefore, should not do for the people what the people can do for themselves. A



Concrete Road

central government has enough to do with its revenues in ways that local self-government cannot, without diffusing its energies upon matters which private enterprise or local organization should control.

It follows that the central administration should, within bounds of equity and magnitude, allot to municipal bodies the necessary authority to control matters within municipal scope, rather than to retain or absorb them. By giving to local authorities the means of organization, they can do much in the way of raising money, and directing the expenditure toward effective road maintenance and

betterment. It is primarily the business of a central government to see that local authorities are provided with the most efficiency means of organization possible, for road purposes.

Centralized Authority

On the other hand, experience in our own and other countries has indicated that a complete system of good roads cannot be created by local organization alone. In older portions of Canada the main roads (though they have suffered by a long period of neglect) were opened and improved by the central governments, or were constructed by toll roads companies. The same was true in the Eastern States, and in the revival of road building there, roads are being built, or are being largely subsidized by State Governments. In the United Kingdom of Great Britain and Ireland the existing main roads were constructed by turnpike trusts; they later passed to counties with an Imperial subsidy for maintenance, but national influence is now being restored. In France the great system of National Highways was built and is maintained by the state; while through subsidies, the influence of the Department de Ponts et Chaussees, is extended to the departmental and communal roads. In Germany the roads were built as military highways by the central government.

The maintenance of main roads, as with construction, has received and is receiving the support of the central governments. In the older countries of England, France, Italy and Germany, the main roads have long since been built, and the present large expenditures of central authorities is almost entirely for maintenance, and it is for road maintenance that their finely organized engineering corps are retained. Central governments should exercise a controlling hand in the maintenance of main roads, which they have built or largely subsidized.

Traffic

It is an axiom that "roads must be built according to the traffic over them"—not the traffic before improvement, but the traffic that will be developed by the improvement, and the potential traffic of expending local conditions.

For the purpose of this address, traffic may be broadly divided into—(1) Horse-drawn vehicles, (2) Fast motor vehicles, and (3) Heavy motor or horse-drawn wagons or trucks.

The traffic of a few farms, all or nearly all horse-drawn, may be sufficiently served by an earth road or light gravel or macadam road. The traffic of a larger district uniting on a single road should have a heavier gravel or macadam surface. As fast motor traffic accumulates, the need for the resistent surface of a high-class pavement becomes necessary. Heavy truck traffic of any kind increases the need for greater strength and mass in the foundation. Such conditions as the foregoing indicate the general basis upon which the type of surface for any road may be selected. It is not good economy to place a pavement at $10,000 a mile where a light gravel road at

$1,000 a mile will serve the traffic; nor is it economically sound to try to keep a light gravel road where traffic demands a heavy permanent.

Construction

Broadly, roads may be divided, for a consideration of construction, into two general classes:

First. Roads for local farm and light market traffic—such as may be drawn from a six or eight mile radius to small towns and shipping points; and

Secondly: Roads adjacent to cities, or which are main routes between large centres of population.

The first of these carry a limited horse-drawn traffic with few automobiles; the second a greater horse-drawn traffic, more heavily loaded wagons and drays, with a considerable proportion of heavy and fast motor vehicles—such roads as those adjacent to Toronto or London, or running from Toronto to Hamilton.

By far the greater part of the country is served by roads of the first mentioned class—probably 90 or 95 per cent.; while about five or ten per cent. will comprise roads of the second class.

Light Traffic Roads

It is characteristic of roads of this class that dependence for foundation is placed almost wholly on the earth sub-grade. To this end, there must be thorough drainage of the soil underlying the road surface. This is the elementary principle of the Macadam road —a dry sub-soil. It is the principle that has so greatly simplified the modern method of roadmaking as compared with the heavy construction of the ancient Romans.

At each side of the road there should be an ample open drain. The roadway, from ditch to ditch should be given a crown or camber. The road surface and sides should be smooth and, if possible, hard, so as to shed water quickly to the side drains. The material used for the travelled surface, gravel or stone, should be so compacted and bonded, that it forms a water-proof cover to prevent moisture passing through it to the earth sub-soil; this, in addition to its service in distributing a concentrated wheel-load over a greater area of sub-soil.

The open drains at the side should ordinarily have a depth of about two feet below the crown of the road. Or the principle of tile under-drainage may be applied, and the need for deep open drains largely done away with. These simple principles, applied with good judgment, are at the basis of all modern road-making.

Roads of Heavy Traffic

Roads adjacent to the larger cities, or roads such as that now being built from Toronto to Hamilton, require a heavier type of construction with a more durable surface, to carry the larger number of vehicles, more heavily loaded, and moving rapidly. The more frequent and faster traffic demands the resistent surface; and added

to this the heavily loaded vehicles require a stronger form of foundation. Into this field enters the Telford foundation, and the concrete foundation, with surface treatment of tar, asphalt, or other binding agents.

The Telford Road, as originally applied, consisted of a hand-laid foundation of stone. These stones of somewhat irregular depth, usually about eight inches, are not laid flat—but stand on edge across the road. Irregular projections are chipped off by workmen with stone hammers; these spalls are wedged into the interstices to strengthen the bond, and over the top is spread a layer of broken stone, the surface being finished in the same way as an ordinary Macadam road.

The bituminous surface is a development of what was originally known as "tar macadam." There are two standard types of construction—"bituminous Macadam" constructed by the penetration method; and "bituminous concrete," constructed by the mixing method.

"Bituminous macadam" as the name indicates, may be described as a macadam road, bonded with tar or asphalt, the bituminous material being poured hot into the interstices of the stone. A four inch layer of stone (such as is retained by a 1½ inch ring will pass a 2½ inch ring) is first spread evenly over the foundation, and rolled to an even surface. Into this the heated bitumen is poured. The pouring may be done either from small cans or from large tank wagons from which it is sprayed under pressure. A penetration of about 2½ inches is usually sought, using about ¾ gallon of bitumen to the square yard. Over this is spread a light coat of stone chips, and the surface is then thoroughly consolidated by a steam roller. It is good practice to then give a paint or squegee coat of bitumen (about ¼ gal. to the square yard), adding another sprinkling of stone chips to dry the surface which is again finally rolled.

The "Bituminous Concrete" is a surface made by the mixing method. Over a layer of broken stone is first sprinkled a light coat of tar as a "binder coat," to unite the surface to the foundation. On this is spread a layer of stone with which hot asphalt or tar has been previously mixed. Mixing was first done by hand, but the practice is now to pass the material through a plant which heats and dries the stone, and in a revolving process similar to the concrete mixer, coats all particles of stone with the bitumen. The coated material is then conveyed to the road, spread and rolled to a depth of 2½ to 3 inches. This is treated with a squegee surface, as in the case of the penetration method.

The mixing method is more expensive than the penetration method; but bituminous concrete is more certain in its results, is more desirable, and will support heavier traffic than will bituminous macadam. In the mixing process, a maximum density of aggregate is sought, using stone carefully graded from fine to large.

One method of proportioning aggregate for maximum density was patented, but similar results are now obtained under what have become known as the Topeka and other Specifications. Another

proprietary form of bituminous pavement is mixed with stone at a central quarry and is shipped by rail for cold construction. Another uses iron slag as the aggregate. Sand in some cases is mixed with the bitumen for use in the penetration process. A variety of minor distinctions might be enumerated.

Ordinary sheet asphalt consists of about 10% bitumen and 90% sand; laid two inches in thickness on a concrete foundation. This material has not been used for roads in the open country; but a concrete foundation with a bituminous concrete surface has been employed in some cases. The latter construction is successfully used in city paving.

There is no hard and fast line between roads in the open country, and city pavements. It is all a matter of traffic and ability to meet the cost. In most cases, the two parallel one another, or by properly applied taxation should be made to do so.

Brick pavements are used largely for roads of the open country in the State of Ohio—where they are manufactured, and the cost is proportionately low. This material has also been largely used in the state roads of New York.

More recently the value of cement concrete as a road surface has been advocated. This is largely due to experience in Wayne County adjacent to the city of Detroit, where a considerable mileage has been laid. Some of the chief characteristics of this pavement are:—A one course mix, about seven inches in thickness; a mixture rich in cement, about 1 : 1½ : 3; thoroughly clean and well proportioned gravel; and the tar coating of joints or cracks to prevent wear.

A Formative Stage

Much of the present practice, in construction for modern conditions of heavy traffic, is in a formative, almost an experimental stage.

The number of elementary materials used or dealt with in road-making is strikingly few, and, with minor exceptions, materials are included in a brief list—sand, clay, gravel, broken stone, asphalt, tar, oils, vitrified brick, creosoted wood, stone setts, and Portland cement.

To these may be added a few materials of local service, such as oyster shells; or proprietary binders, such as Rocmac or Glutrin. While the elementary materials are few in number, the range in quality is wide, their combinations are many, conditions of traffic are of varying degree, and such factors as climate, workmanship and cost must be considered.

In the solution of road problems, at the present time, effort is being given by scientific engineers to the accumulation of facts respecting road materials and their action under climate and traffic. Much has been done in the past five years in this regard, and it is confidently expected that the next five will do more. Experience will then more nearly approximate the anticipated life of new materials and new methods. The status of knowledge respecting road construction in the next five years will largely depend on the

care and thought with which any users at the present time, assemble facts, and correlate them with definite standards of traffic.

Road construction and maintenance to a high standard of efficiency is being found in all countries, a matter of much expense and the cause of increased taxation. England, France, the United States, are all seeking means less costly than are now available. A road of satisfactory quality, which can be laid for one dollar a square yard, is an ideal towards which we may well strive; a road for instance, to consist of a concrete foundation, with a bituminous or similar surface, the latter to have a life, with reasonable repair, of ten years. Such a road, if attainable, would go far to solve the road problem of to-day.

THE ATLANTIC AND INTRACOASTAL WATERWAYS

By T. Kennard Thomson, '86, D.Sc.

A glance at the coast line of the United States from Maine to Florida will show that Nature has made the construction of inland waterways along the coast wonderfully simple, having by means of sand banks, rivers and bays, performed most of the work for man, making it possible by means of artificial canals here and there—with more or less dredging in existing waterways—to obtain sufficient water for safe passage of barges from Maine to Florida.

This kindness of Nature was seen and taken advantage of by Congressman J. Hampton Moore, and others, and resulted in the organization of The Atlantic Deeper Waterways Association in 1907, to promote the construction of the series of canals linking the natural bays, rivers and sounds along the Atlantic seabord in order to provide a modern protected free waterway, admitting heavy traffic, owned and operated by the United States Government, between New England and Florida.

The Association has succeeded by getting various acts through Congress, in having a complete survey of the proposed routes made by the United States Government Engineers.

The East Coast of Florida has already a chain of natural protected waterways connected by canals constructed by corporations. In the southern portion, the State is now constructing a series of canals in order to drain the Everglades. Connection will undoubtedly be made between Jacksonville, Florida, on the Atlantic coast, with the Gulf of Mexico, via the magnificent St. Johns River and a connecting canal.

A seven foot deep canal is already under construction from Jacksonville, Florida, to Charleston, South Carolina. From Charleston, South Carolina, to Beaufort, North Carolina, a seven foot canal is recommended.

From Beaufort, North Carolina, to Norfolk, Virginia, a twelve foot depth is desired—via a short canal from Beaufort to Pamlico Sound; another canal to connect Pamlico with Albermarle Sounds and then to Norfolk and up the Chesapeake Bay to Baltimore and Chesapeake City, and by the Chesapeake and Delaware Canals


THE ATLANTIC
INTRA-COASTAL WATERWAY
SHOWING INTERCONNECTED BAYS AND RIVERS
AND INLAND CONNECTIONS
SCALE OF MILES
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
LAKE ONTARIO
LAKE ERIE
GEORGIAN BAY
QUEBEC
MONTREAL
OTTAWA
ST MARY'S FALLS CANAL
HOUGHTON
ESCANABA
MILWAUKEE
CHICAGO
GARY
DETROIT
TOLEDO
CLEVELAND
ASHTABULA
ERIE
TORONTO
ROCHESTER
LOCKPORT
BUFFALO
OSWEGO
WATERTOWN
ROME
UTICA
SCHENECTADY
SYRACUSE
SENECA FALLS
BINGHAMTON
ELMIRA
PLATTSBURG
BURLINGTON
WHITEHALL
GLENS FALLS
SCHUYLERVILLE
TROY
HUDSON
KINGSTON
POUGHKEEPSIE
NEWBURGH
HARTFORD
NEW LONDON
NEW HAVEN
BRIDGEPORT
SCRANTON
WILKESBARRE
WILLIAMSPORT
LOCK HAVEN
BELLEFONTE
HARRISBURG
READING
EASTON
BETHLEHEM
PATERSON
HACKENSACK
NEWARK
NEW YORK
PERTH AMBOY
NEW BRUNSWICK
TRENTON
BRISTOL
BORDENTOWN
BURLINGTON
PHILADELPHIA
CHESTER
BARNEGAT
WILMINGTON DEL
SALEM
NEW CASTLE
HAVRE DE GRACE
BRIDGETON
CAPE MAY
CAPE HENLOPEN
LEWES
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ELIZABETH CITY
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EDENTON
DANVILLE
WELDON
PLYMOUTH N.C.
WASHINGTON N.C.
CAPE HATTERAS
RALEIGH
GOLDSBORO
NEWBERN
BEAUFORT N.C.
FAYETTEVILLE
ELIZABETHTOWN
WILMINGTON N.C.
SOUTHPORT
CAPE FEAR
CONWAY
COLUMBIA
GEORGETOWN
CHARLESTON
ATLANTA
AUGUSTA GA.
BIRMINGHAM
MILLEDGEVILLE
MACON
DUBLIN
BEAUFORT S.C.
SAVANNAH
TUSCALOOSA
SELMA
MONTGOMERY
COLUMBUS
HAWKINSVILLE
JACKSON
EUFAULA
ALBANY
DARIEN
BRUNSWICK
FERNANDINA
BAINBRIDGE
JACKSONVILLE
ST AUGUSTINE
GREEN COVE SPRINGS
PALATKA
GULFPORT
MOBILE
PENSACOLA
APALACHICOLA
NEW ORLEANS
CEDAR KEYS
ORMOND
DAYTONA
NEW SMYRNA
DELAND
SANFORD
TITUSVILLE
CAPE CANAVERAL
KISSIMMEE
TAMPA
ST PETERSBURG
ST LUCIE
PUNTA GORDA
PALM BEACH
FT MYERS
FT LAUDERDALE
MIAMI
KEY WEST
EASTPORT
BANGOR
BAR HARBOR
WATERVILLE
AUGUSTA ME.
ROCKLAND
AUBURN
BATH
PORTLAND
SACO
KENNEBUNKPORT
PORTSMOUTH N.H.
CONCORD
NEWBURYPORT
GLOUCESTER
LYNN
BOSTON
LOWELL
QUINCY
BROCKTON
CAPE COD
PLYMOUTH MASS
TAUNTON
PAWTUCKET
PROVIDENCE
FALL RIVER
NEW BEDFORD
HOLYOKE
SPRINGFIELD

(to be enlarged) to Delaware City on the Delaware River; another short canal will connect the Delaware River with South Amboy, N.J., near the end of Staten Island, New York, connecting there with Kill von Kull and then with the Hudson River to Albany, thence via the New Barge Canal to Oswego on Lake Ontario and Tonawanda, on the Niagara River; and also via the Hudson River and Champlain Canal to Lake Champlain, which will eventually be connected with the St. Lawrence River below Montreal.

From New York safe passage can also be had along the Long Island Sound and through the recently completed Cape Cod Canal.

Two other projects are being considered—one a protected waterway through the lagoons of Rhode Island, and the other a waterway connecting Narragansett Bay with Massachusetts Bay and Boston Harbor.

Summary

St. Johns River, Fla., to Fernandina, Fla., 7 feet depth. Work under way	$251,726
Fernandina, Fla., to Savannah River, Ga., 7 feet depth. Work under way	195,000
Savannah River, Ga., to Charleston Harbor, S.C., 7 feet depth. Work under way	427,400
Charleston Harbor, S.C., Winyah Bay, S.C., 7 feet depth. Construction recommended	1,227,800
Winyah Bay, S.C., to Little River, S.C., 7 feet depth. Construction recommended	5,677,800
Little River, S.C., to Cape Fear, N.C., 7 feet depth. Construction recommended	3,724,219
Cape Fear, N.C., to Beaufort, N.C., 7 feet depth. Construction recommended	2,872,111
Total Southern Section Atlantic Intracoastal Waterway, St. Johns River, Fla., to Beaufort Inlet, N.C., in round numbers	$14,400,000
Beaufort Inlet, N.C., to Norfolk, Va., 12 feet depth. Project approved by Congress; work partly completed. Chesapeake and Albermarle Canal purchased. Much of the route lies in Pamlico and Albermarle Sounds, natural waterways requiring no improvement	$ 5,400,000
Norfolk, Va., to head of Chesapeake Bay, Md. Natural waterways requiring no improvement.	
Chesapeake Bay to Delaware River, 12 feet depth. Recommended for immediate action, including purchase or condemnation of existing Chesapeake and Delaware Canal	10,514,290
Delaware City, Del., to Bordentown, N.J. Route follows channel of the Delaware River, for which present depth is sufficient over the entire distance, assuming a 12 feet project.	

Bordentown, N.J., to South Amboy, N.J., 12 feet depth. Immediate construction recommended......	20,000,000
South Amboy, N.J., to New York Bay (and thence to Hudson River and Long Island Sound). Natural waterways requiring no improvement for a 12 foot project.	
Total Northern Section Atlantic Intracoastal Waterway, Beaufort Inlet, N.C., to New York Bay, in round numbers..................................	36,000,000
Total cost, Atlantic Intracoastal Waterway, as recommended by the Army Engineers..................	50,400,000

The following sections of the Intracoastal Waterway route have been surveyed by the Army Engineers, and, while not adversely reported, consideration is postponed until more progress has been made on the foregoing sections:

Key West, Fla., to Indian River, Fla., 7 feet depth..	$2,127,950
Indian River, Fla., to St. Johns River, Fla., 7 feet depth	2,491,056
Fisher's Island Sound, Conn., to Narragansett Bay, R.I., 18 feet depth................................	12,322,000
Narragansett Bay, R.I., to Boston Harbor, Mass., 18 feet depth..	29,590,000

Connected Projects

In New York Harbor, the East River and the Bronx Kills, improvements recommended by the Engineers will facilitate barge traffic from the Intracoastal Waterway and the Upper Hudson to Long Island Sound..	$13,400,000
New York City to Troy, N.Y. Route follows the Hudson River; a natural waterway undergoing improvement between Hudson and Troy, 12 feet depth (but a greater depth advisable). Work under way..	5,000,000
New York State Barge Canal, Troy, N.Y., to Tonawanda, N.Y., and Troy, N.Y., to Lake Champlain, N.Y., 12 feet depth.............................. State project, rapidly approaching completion.	126,000,000
Cape Cod Canal; Buzzards Bay, Mass., to Barnstable Bay, Mass., 25 feet depth .... Constructed by a private corporation; completed.	12,000,000

Length of Connecting Canals, Atlantic Intracoastal Waterway

	Length of Excavation
1. New Jersey Canal (new project)......................	33.7 miles
2. Chesapeake and Delaware (existing canal to be enlarged)..	13.7 miles
3. Chesapeake and Albermarle (project adopted; existing canal being enlarged)............................	11.4 miles
4. Albermarle and Pamlico (Alligator River and Rose Bay) project adopted.............................	26.3 miles
5. Beaufort Cut (project adopted; existing canal to be enlarged)..	6 miles
6. Beaufort to Cape Fear River, N.C., (new project)	

about	5 miles
7. Cape Fear River to Little River, S.C., (new project) about	20 miles
8. Little River, S.C., to Winyah Bay, S.C. (new project) about	15 miles
Total Intracoastal Waterway links	131.1 miles

Total length of continuous navigation made possible by above canals connecting existing waterways (about)	1800 miles
Mileage of 148 rivers interconnected by Intracoastal Waterway	5365 miles
New York Barge Canal System, including Central Lakes	500 miles
Total length of Great Lakes, which will connect with Intracoastal Waterway	1489 miles
Lake Champlain, 126 miles; Richelieu River, 65 miles	191 miles
St. Lawrence River (about)	1000 miles
Canadian Inland Waterway (Georgian Bay Canal)	400 miles

Average Tariff per Ton Mile

Earthen Roads by animal power	25 cents
Steam railroads	7.8 mills
Canals	2 to 3 mills
Rivers, sounds, etc	1 mill
Lakes and ocean	0.5 mill

This wonderful length of inland waterways can thus be obtained for the depth specified, for the extremely small amount of fifty million dollars, which looks like a small outlay for the United States Government, when compared with one-hundred-and-fifty million dollars spent by New York State alone, on its waterways; or with the fifty million dollars for a New Welland Canal.

The saving in life and property will amount to enormous figures annually, and in addition the Government will have safe channels for submarines and other war vessels.

Sooner or later the whole system will be deepened and widened, where necessary, for boats of 30 feet draft or more.

In order to ensure this good work by educating the public to the necessity thereof, the Atlantic Deeper Waterways Association has held conventions in the following cities, starting in 1907 at Philadelphia, then at Baltimore, Md., Norfolk, Va., Providence, R.I., Richmond, Va., New London, Conn., Jacksonville, Fla., and this year starting at New York City and spending five days on the Hudson River.

The convention this year was held on the "Berkshire," the largest river boat afloat, with 700 delegates and guests. Stops were made at Newburgh, West Point, Poughkeepsie, Kingston, Hudson, Albany and Troy, and the enthusiasm aroused along the entire route was certainly inspiring, and it was estimated that the people of these cities must have spent over $50,000 in entertaining our party.

In recognition of his project for a really greater New York, Governor Glynn appointed the writer a delegate to represent the State of New York at this convention.

The convention in the fall of 1915 will be held at Savannah, Ga.

VALVE DIAGRAMS AND THEIR APPLICATION

Part I.

By M. L. Smith, B.A. Sc., '11
Associate Editor "*The Power House*"

To the man who is constantly employed about steam engines the solution of valve problems by means of diagrams is a matter that is easily understood. The technical student, however, will be much helped if he will take the trouble to lay out a properly proportioned valve seat upon one piece of paper and the corresponding valve on another. By moving this model valve upon its seat as the engine cycle is studied by means of the diagram, the relation of all the events of the revolution to each other at any time will be more easily grasped.

Most of the calculations pertaining to valves and their relation to the other parts of the engine involve difficult mathematics. For this and other reasons it is usual to obtain results graphically by means of diagrams—that is by drawing all parts full size or to a scale and actually measuring lengths with a rule. Valve diagrams then are employed in general practice as follows:

(1) To determine lap, displacement, angular advance and other facts in connection with existing valves.

(2) To design and proportion certain parts of new valves and their gearing.

A number of different diagrams are employed for this purpose, chief of which are the Zeuner, which is used mostly in Europe, and the Bilgram, which is quite popular in America. For a number of reasons the latter is easier for mechanics to understand and apply, and so we will confine ourselves largely to it.

The Bilgram Diagram

This diagram was devised by Hugo Bilgram, of Philadelphia, and depends for its proof upon a geometrical proposition which says that if two angles and a side of one triangle be respectively equal to the corresponding two angles and side of another triangle, the two triangles are equal in every respect. This is seen in Fig. 1. In the triangles bBO and QOq, the side BO is equal to QO, as they are radii of the same circle. The angle QOq has been made equal to the angle BOb and the angles BbO and QqO are equal, because they are right angles. Now according to geometry, the two triangles are equal in every way —that is, the line bB is equal to Qq.

The angle of advance may be determined by drawing from (b) a line bB equal to the lap plus lead and joining BO, the angle of advance being bOB. We have just seen that the lap plus lead can just as well be measured up from (q), and can be represented by the line qQ. The angle of advance now is QOq

instead of BOb. This is what is done in the Bilgram diagram.

In connection with the designing of valves, all or some of the following facts are easily obtained:—

(1) The throw of the crank may be determined from the stroke of the engine.

(2) The maximum port opening is usually determined by calculation, or, if the same as the port, its width can be measured.

(3) The throw of eccentric and travel of valve can be measured.

(4) The lead is determined by judgment and practice of the designer.

(5) The point of cut-off—that is, the proportion of the

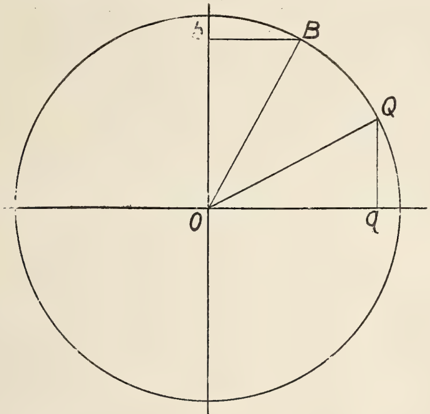

Fig. 1—Simple proof of the principle of the Bilgram Diagram

stroke at which cut-off takes place, is usually a matter for the designer's judgment.

(6) The point of compression or the point in the stroke at which exhaust closes.

It may be required to find, by means of the diagram, some of the above and any other information, such as inside and outside lap, angle of advance, crank positions for the different events of the engine stroke, positions of the valve corresponding to various positions of the crank, width of port opening at any point in the stroke, etc.

The Complete Diagram

The diagram must be accurately drawn to some scale. Either full size or an enlarged scale is best. The crank pin circle with its diameters may be drawn to a different scale from the rest of the diagram, thus in the illustration Fig. 2 the stroke is represented half size and the valve diagram is drawn full size. Proceed as follows:

(1) Draw a horizontal centre line AH to represent the engine stroke, and, using this line as a diameter, draw the crank pin circle as shown to the predetermined scale.

(2) From the same centre and with a diameter equal to the travel of the valve construct the valve travel circle. Its radius will, of course, be equal to the eccentricity.

(3) Still using the same centre, draw the maximum port opening circle with a radius equal to the greatest port opening.

(4) Assuming that the cylinder is to the left of the crank,

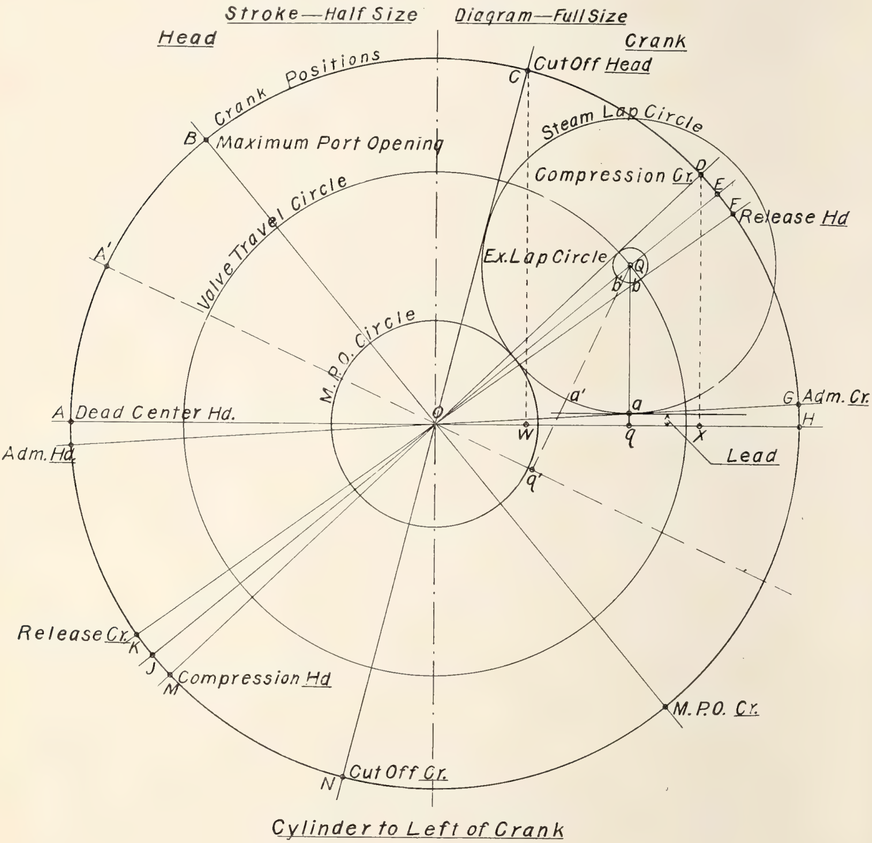

Fig. 2—Complete Bilgram Diagram

and that we are considering the forward stroke, measure off from A the proportion of the stroke at which cut-off is to take place —namely, Aw, which is ⅝ of the stroke, and, therefore, ⅝ of the distance AH. From (w) draw a vertical line to cut the crank pin circle at C. This point C represents the position of the crank pin when cut-off occurs. Through C draw a crank line CN. By

a crank line is meant a diameter of the crank pin circle through any crank position.

(5) From the dead centre crank line measure upwards a distance (qa) equal to the lead, and through (a) draw a short horizontal line. Call this the lead line.

(6) Draw in the steam lap circle. Its centre must be on the valve travel circle, and it must touch three points—namely, the lead line at (a), the M.P.O. circle, and the cut-off crank line.

(7) In the same way as the point of cut-off was determined, measure from A a distance Ax representing the proportion of the stroke at which compression is to take place. Through (x)

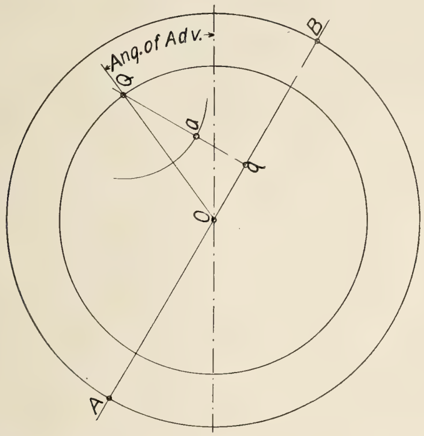

Fig. 3—Use of Bilgram Diagram to determine displacement and port opening.

draw a vertical line cutting the crank circle at D. This is the crank position for compression in the other end of the cylinder. For head end compression, draw a crank line through D, which will cut the crank circle at the desired crank position M.

(8) From the same centre as the steam lap circle draw the exhaust lap circle so that it will just touch the compression crank line. The exhaust lap is represented by the radius of this circle. Draw a crank line F K so as to touch the other side of the exhaust lap circle. This gives the two crank pin positions for release—namely, F and K. The crank position for admission depends upon the lead; hence, draw a crank line through the lead line at the point (a) and the centre of the crank circle C. This gives the two points of admission G and I. Providing that the ports, lap, etc., are the same for both ends of the valve, the crank positions for similar events in opposite ends of the cylinder will be found at opposite ends of diameters of the crank pin circle.

Studying the diagram, Fig. 2, a number of facts will be understood. The crank pin circle, crank lines and all lines per-

taining to the crank are drawn to a certain scale. All other lines relate to the valve, and, therefore, should be drawn to a uniform scale, which may be the same as for the crank parts or different. Throw of the eccentric or valve displacement is represented by the radius of the valve travel circle, and the travel of the valve is represented by its diameter. By displacement of the valve is meant the distance it moves in either direction from its mid-position. The maximum port opening is represented by the radius of the M.P.O. circle.

The maximum port opening is always less than the width of the cylinder port in good design as the latter must be wide enough to accommodate the exhaust steam.

Steam lap is represented by the radius of the steam lap circle and exhaust lap by the radius of the exhaust lap circle. Lead is represented by the distance of the lead line above the horizontal diameter or base line. Note carefully that the radius of the valve travel circle is equal to the radius of the M.P.O.

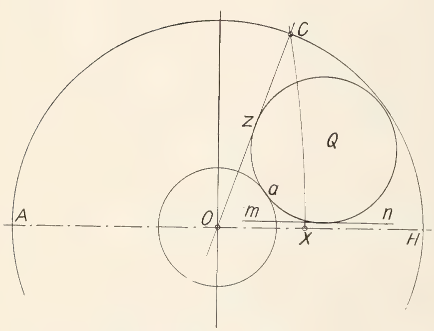

Fig. 4—Use of Bilgram Diagram to determine point of cut off.

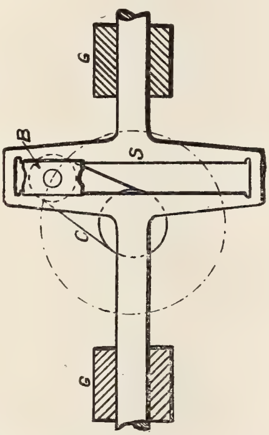

Fig. 5—Scotch yoke or slotted cross head in which there is no angularity of connecting rod.

circle plus the radius of the steam lap circle. The travel of the valve is, therefore, equal to twice the lap plus the maximum port opening.

The displacement of the valve when the crank is at A or on dead centre, is equal to the distance Qq or the lap plus the lead. The line Qq is a vertical from the centre of the steam lap circle to the crank line for the above crank position. Qa represents the lap, while (aq) represents the port opening, which in this case is equal to the lead. For any other crank position, such as A^1, the displacement is equal to the vertical Qq^1 on the crank line as before. The lead is Qa^1 and the amount of port opening is (aq).

At the crank position B, the vertical QO on the crank line reaches its greatest length; hence, the crank position B is the position for maximum port opening. At C the vertical distance is equal to Qz, Fig. 4, which is the same as the lap, therefore, there is no port opening, and C is the point of cut-off. This same reasoning can be carried out in connection with the exhaust lap, but is never required.

In the cut, Fig. 2, the complete diagram is represented. This, however, is rarely required. For instance, if the port opening or displacement only is required for a given crank position, such as A, Fig. 3, all that is required is to draw the crank line for this position, lay off the angle of advance by the line OQ as shown, draw in a small section of the valve travel circle, and draw the line Qq vertical to AB. Draw a small section of the steam lap circle as shown. The part Qa is the lap, (aq) is the port opening, and Qq is the displacement.

Again, suppose an engineer requires to find the exact point at which cut-off takes place. He draws the base line and the crank pin circle, as in Fig. 4. Next comes the M.P.O. circle and the steam lap circle. The crank line can now be drawn, touching the steam lap circle at (z). This will give the crank pin position C for cut-off, from which the piston position can be found by drawing the arc as shown from a centre on the base line and with a radius equal to the length of the connecting rod to the scale of the crank pin circle. The position of the piston will be at (x). The distance Ax can now be measured, and the percentage of the stroke which it represents is easily calculated.

These statements are correct only in cases where a Scotch yoke or similar form of cross head, as in Fig. 5, is used. The effect of the connecting rod will be dealt with in the next number of this series.

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* THE WORK OF OUR LATE DEAN GALBRAITH

By G. H. Duggan, '83

I am deeply sensible of the honor of being asked to address you on the subject uppermost in our thoughts to-night, the work of Dean Galbraith: our School, this Society and I think I may include to a large extent the present standing of the Engineering profession. Everyone interested in engineering in Canada to-day knows full well the influence of the School and the large part it has played in the development of the country and every member of it, graduate or undergraduate, must be proud of its position, but particularly we who joined the School in its early days, when the world of engineering was young, when the engineer was of no account, scorned by the captains of industry, when his technical education was rather a handicap and on graduation he was often glad to take a job of pulling a

* Extract of address delivered at a meeting of the Engineering Society in Convocation Hall on Dec. 9th, 1914, dedicated to the memory of our late Dean John Galbraith.

chain, holding a rod or of even driving stakes. To us it is a revelation to see what has been accomplished in less than a generation. In that short space of time the whole status of engineering and of the School has undergone a wonderful change; the engineer has arrived, he is sought by corporations, our great railways and our great industrial companies are manned by engineers, many of them to the very top. The older professions now recognize that we hold an important place in the community and I confidently expect many of the present members of this society will see engineers occupying the highest positions in the gift of the nation.

In the elevation of the engineer in the community there have, of course, been other factors as well as the School, but I think we can fairly claim that in the number and the influence of our graduates our School has by far the leading place. It is a proud position, but at the same time it brings with it the responsibility of maintaining this position and we must do some hard thinking and planning to discharge it. Before laying out plans for the future, it is always well to examine the ground, survey the situation and ascertain how the position has been attained. It seems that there is not likely to be much difference in the actual technical instructions imparted by first class schools and so far as this is concerned, we are without sensible advantage or disadvantage compared to other like institutions. If that be so, our standing is not due only to the excellence of our instruction and we must look farther for the real cause. To my mind we owe it to the spirit which seized the School in its early days, the loyalty, the esprit de corps, the pride which each has in his alma mater and in the achievements of other members of the School; in fact, to that something that is difficult to define which seems to me to be akin to the patriotism that makes a nation great. All of us know how this spirit came to the School. The School was started and fostered and built up by a man of wonderful personality, revered and loved by all, with the rare gift of inspiring others with his enthusiasm—a very leader of men, Dean Galbraith.

No eulogy can add lustre to the name of Dean Galbraith or to the reverence in which it is held, but because I have known him for so long and so intimately I cannot refrain from giving something of my own experience.

We were very few in those days, only three graduating in my year, and we were fortunate in getting much of the Dean's time. Later, when I became his assistant for a short time, I shared his office and knew him even better. We all admired the Dean and were hopeful with him for the future of the School, but I do not think anyone in those days, even the Dean himself in his most sanguine hopes, imagined it would come to the strength and power it has. As years went on I marvelled at his success, recognized more and more his sterling qualities and valued his friendship the more highly.

I want to pause for a moment to refer to this Society because I see in it a strong evidence of the Dean's ability as an organizer, and I know he valued it greatly as an educational aid and for the influence it has upon the life of the School. In my time we were, unfortunately, too few to organize an Engineering Society, and we

were thus debarred its benefits, but I feel that this Society is by far the most helpful single influence in the success of the School and particularly in the after success of its graduates. Under its auspices men get away to some extent from the hard facts of technical instruction; they learn to know each other outside the classroom, friendships are made, and the traditions are created which have held the graduates together, and established the esprit de corps before referred to.

It is rather typical of the Dean's methods that he should nominally have retired from direction of the Society, which he was so interested in starting, as soon as it could stand on its feet but at the same time continue to watch it with fatherly care and I am sure he carefully guided its work to the last.

To revert to our loss; it is staggering and seems almost irreparable but it is not the spirit of the Canadian engineer or that which the Dean imbued, to halt or be dismayed by seeming disaster, and "the good men do, lives after them." Materially we have the consolation of knowing that Dean Galbraith has left us well organized to carry on the work so well started and we have the good fortune to have a man thoroughly equipped and capable of leading us to further achievements. My old friend Dr. Ellis is particularly fitted for that task; through all the years of the School from its very beginning he has stood shoulder to shoulder with Dean Galbraith, sharing much of his actual work, and I do not doubt, giving inspiration and unostentatiously contributing to our success. Still with all his qualifications, Dr. Ellis' task is an arduous and difficult one, and we of this Society owe it to the memory of Dean Galbraith and to the School to assist Dr. Ellis and lighten his labours to the best of our ability. It seems to me we can best do this and at the same time pay tribute to the memory of Dean Galbraith by keeping his example before us and conducting affairs as if he were still guiding.

To us who have worked with Dean Galbraith, no other course seems possible, but there are many more to come who will not have had that privilege and we, too, must pass on. To those following let us hold up the ideal of Dean Galbraith. I am at a loss to suggest how this should be done, but I know there are many actively in touch with School affairs, imbued with the spirit of Dean Galbraith who will make it their interest and pleasure to plan the practical details for carrying on the work of the Society and to keep his memory green before the future graduates and the profession.

Watson-Lockwood

On December 25th, Mr. F. E. Watson, B.A.Sc., '11, demonstrator in drawing, University of Toronto, was united in marriage to Miss A. R. Lockwood, daughter of Mrs. C. K. Lockwood, Brighton, Ont.

Sheppard-Meservey

On Monday, November 30th, 1914, Mr. A. C. T. Sheppard, D.L.S., '07, topographer with Geological Survey of Canada, was

united in marriage to Miss Lillian Hamilton Meservey, only daughter of Mr. and Mrs. M. C. Meservey, of Montreal. After a trip to Boston and New York Mr. and Mrs. Sheppard returned to Ottawa, where they will reside until Mr. Sheppard's departure with the second overseas contingent.

Harris-Mitchell

Mr. Joseph H. Harris, B.A.Sc., '10, son of Mr. and Mrs. John B. Harris, Toronto, was united in marriage to Miss Helen E. Mitchell, daughter of the late Mr. and Mrs. Robert Mitchell, on Saturday, January 2nd.

The following "School" men have volunteered for active service with the Canadian Engineers of the Second Contingent and are now encamped at Ottawa with the 6th Field Company:—Lieutenant C. Hughes, '09; with the 5th Field Company:—Sergt. W. B. Redman, '15; B. H. Hughes, '16; W. G. Brown, '16; F. Alport, '06; H. W. Frogley, '11; C. H. Hopkins, '09; H. R. Jardine, '09; A. H. Munroe, '10; with the 4th Field Company:—Lieutenant D. J. Miller, '10; Corporal A. C. T. Sheppard; with the Signal Company:—Sergt. C. E. MacDonald, '16; A. E. Stewart, '11; A. W. Crawford, '14; J. M. Strathy, '13; W. E. Lockhart, '15; F. D. Austin, '15; and J. J. Stock, '08.

Eugene W. Stern, '84, who has a practice as consulting engineer in New York and is secretary of the American Institute of Consulting Engineers, has been appointed chief engineer of the Bureau of Highways, Borough of Manhattan, New York city.

W. C. Murdie, M.A.Sc., '13, is with the Geodetic Survey of Canada, Department of Interior, Ottawa.

Mr. A. C. T. Sheppard, D.L.S., '07, of the Geological Survey of Canada, is with the second overseas contingent in the 4th Field Company of Canadian Engineers, at Lansdowne Park, Ottawa, Mr. Sheppard holds the rank of corporal in this company.

W. A. Richardson, B.A.Sc., '11, is with the headquarters staff, 3rd Brigade, Canadian Field Artillery, 1st Contingent. R. V. Macaulay, B.A.Sc., '11, is with the 5th Battery, 2nd Brigade, Canadian Field Artillery, 1st Contingent.

J. L. Whitside, B.A.Sc., '10, is bridge engineer, office of Highway Commissioner, Provincial Government, Winnipeg, Man.

G. F. Dalton, B.A.Sc., '14, is with the Geodetic Survey of Canada, Department of Interior, Ottawa.

J. L. G. Stuart, B.A.Sc., '07-'08, has been appointed resident engineer for the Burlington section of the Toronto-Hamilton highway.

A. B. Mitchell, '08, is engineer in charge of construction on the waterworks extensions for the town of Orillia, Ont.

Geo. T. Clarke, '06, vice-president of Richardson Bros., Limited, of Saskatoon and Winnipeg, has been appointed by the department of Public Works, Ottawa, to superintend excavation for the foundation work of the new Saskatoon post-office.

A. M. MacKenzie, B.A.Sc., '14, is wire-chief, Bell Telephone Co., Guelph, Ont.

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EDITORIAL

The Twenty-sixth Annual Dinner of the Engineering Society will be held on Friday, February 12th, at 8 p.m., in the Prince George Hotel.

Among the speakers of the evening will be Mr. Thos. R. Deacon, '91, President and General Manager, Manitoba Bridge and Iron Works, Limited, and ex-Mayor of Winnipeg; Hon. W. H. Hearst, Premier of Ontario; and Mayor T. L. Church, Toronto. A good entertaining programme and a particularly good menu has been arranged for. The price of tickets will be $1.75.

"SCHOOL" MEN REPRESENTED AT McGILL SCIENCE DINNER

The Fifth Annual Dinner of the Science Undergraduate Society of McGill University was held on Friday, January 22, 1915, in the McGill Union, Montreal. Mr. C. R. McCort, Chairman of the Civil Club, was present as a Representative of the Engineering Society of the University of Toronto, and responded to the toast to Sister Universities. This toast was also responded to by representatives from Queen's and Laval. The principal speakers of the evening were Principal Peterson and Dean Adams of McGill, Dean Goodwin of Queen's, Mr. H. F. Meurling, M.Can.Soc.C.E., Lieut.-Col. Starke of McGill C.O.T.C., Prof. John McNaughton, Dean Walter of Arts, Dean Berkett of Medicine, and Dean Lee of the Faculty of Law.

Although the attendance was not quite so large as at some similar functions in the past, the dinner was a decided success, and thoroughly enjoyed by all. Dean Adams, in replying to the toast to the Faculty, congratulated the men on the excellent work being done in the C.O.T.C. and mentioned the fact that 78 of their Undergraduates in Science are already on their way or at the front. Owing to the great amount of time required for military work, it had been decided by the Faculty to grant each man a bonus of 10 per cent. on each subject, at the Annual Examinations. Dean Goodwin of Queen's, spoke highly of the work being done at McGill, and said that they were labouring under difficulties at Queen's, due to the fact that so many of their men had gone to the front.

After many words of wisdom spoken and humorous touches given by the several speakers, the banquet came to a close, by all joining hands and singing "Auld Lang Syne," followed by the McGill yell.

OTTAWA GRADUATES ENTERTAIN SCHOOL MEN OF THE SECOND CONTINGENT

On Wednesday evening, January 14, at the Univeristy Club, Ottawa, the graduates who are residents of the Capital City, entertained the School men who have enlisted with the Second Contingent and who are now in barracks at Lansdowne Park, Ottawa. Sixty four were present, of whom sixteen were guests of the evening. Mr. R. A. A. Johnston, '88, of the Geological Survey, presided, and the following members of the executive of the Ottawa branch of the Engineering Alumni Association occupied seats at the head table: Thomas Shanks, '99, president; J. B. Challies, '03, secretary; W. F. M. Bryce, '08, treasurer, and Messrs. R. S. Smart, G. E. Stacey, F. Withrow, G. H. Ferguson and R. W. Morley.

Telegrams of congratulations and best wishes were read from the

Calgary, Winnipeg and Vancouver branches of the Engineering Alumni Association, the Toike Oike Club of Montreal, Prof. C. H. C. Wright and Mr. H. Irwin of Toronto and Dr. T. Kennard Thomson, of New York. The trim military uniforms, the tastefully arranged bunting and the patriotic songs and speeches harmonized with the other outward and visible signs of a loyalty to country and an enthusiasm for the cause of empire which were in constant evidence during the meeting. The toasts to "The King," "The School," and "Our Guests" were honored in the traditional school spirit and the insistent demand for speeches drew from the boys in khaki many responses expressive of gratitude for the brotherly regard of their Ottawa friends.

The musical programme which was under the direction of Mr. Alan Fraser, '10, came in for deservedly favorable mention and was one of the most enjoyable features of a decidedly pleasant reunion.

At the close of the dinner the rooms of the club were placed at the disposal of the party and an opportunity was given to make new acquaintances and to renew old friendships. The guests of the evening, members of the Second Contingent, were: F. Alport, '06; A. C. T. Sheppard, '07; J. J. Stock, '08; C. H. Hopkins, '09; C. Hughes, '09; D. J. Miller, '10; G. H. Munro, '10; H. W. Frogley, '11; J. W. V. Strathy, '13; A. W. Crawford, '14; W. G. Brown, '16; W. E. Lockhart, '15; W. B. Redman, '15; C. E. Macdonald, '16; B. H. Hughes, '16.

H. M. Weir, B.A.Sc., '00, is employed in the city engineer's office, Saskatoon, Sask.

C. W. Hookway, B.A.Sc., '06, is with the Westinghouse Manufacturing Co., Hamilton, Ont.

J. W. Withrow, '90, is in the Patents Office, Department of Agriculture, Ottawa.

D. G. Munroe, '07, is resident engineer, Lake Erie & Northern Ry., Brantford, Ont.

O. L. Flanigan, B.A.Sc., '08, is in charge of construction work for C. H. and P. H. Mitchell in connection with the Cobalt Lake Drainage Scheme, Cobalt, Ont.

F. S. Falconer, B.A.Sc., '09, is with the Geological Surveys, Department of Interior, O tawa, Ont.

R. H. Hall, '09, is with the Customs Department, Ottawa, Ont.

N. C. A. Lloyd, '09, is with Brown & Brown, surveyors, 2 Toronto St., Toronto.

G. L. Kirwan, B.A.Sc., '10, is with the Topographical Surveys Branch, Department of Interior, Ottawa.

M. B. Bonnell, '04, is in the Patents Office, Department of Agriculture, Ottawa.

R. Neelands, '06, is with the Topographical Surveys Branch, Department of Interior, Ottawa.

J. O. Roddick, B.A.Sc., '06, has a contracting practice at Brantford, Ont

A. M. Carroll, '08, is with the Sovereign Construction Co., Toronto, Ont.

R. E. K. Neelands, B.A.Sc., '07, is surveyor at the Coniagas Mine, Cobalt, Ont.

P. E. Hopkins, B.A.Sc., '10, is geologist with the Bureau of Mines, Ottawa.

C. A. Morris, B.A.Sc., '09, formerly with the Canadian Copper Co., is now with the Hollinger Mine, Timmins, Ont.

W. Hutchings, B.A.Sc., '14, is assayer, O'Brien Mine, Cobalt, Ont.

P. W. Meahan, B.A.Sc., '14, is employed in the cyanide plant, O'Brien Mine, Cobalt, Ont.

J. Carter, B.A.Sc., '14, is in the cyanide plant, Nipissing Mines, Cobalt, Ont.

W. A. O'Flynn, B.A.Sc., '11, is with the Temiskaming Mine, Cobalt, Ont.

At the annual meeting of the Toronto Branch of the Canadian Society of Civil Engineers the following officers were elected for the ensuing year:—Chairman, J. W. R. Ambrose; council, J. G. G. Kerry, W. A. Bucke, Geo. A. McCarthy, A. F. Stewart (ex-officio); secretary, C. H. R. Fuller; Library committee, A. L. Mudge, W. A. Hare, J. R. Cockburn, H. J. Bowman.

DIRECTORY OF THE ALUMNI

A

Acres, H. G., '03, is associated with the Hydro Electric Power Commission, Toronto, as hydraulic engineer. He is now engaged in work at Kenora, Ont.

Adams, J. H., '10. His home address is 25 Maynard Ave., Toronto. He is a member of the Adams Mfg. Co., 300 Yonge St., Toronto.

Adams, O. F., '10, is with the Hydro Electric Power Commission of Ontario at Toronto.

Adsett, F. C., '14, is engineer for the Light and Heat Commissioners, Guelph, Ont.

Agnew, N. J., '10, has 56 Victoria Ave. S., Hamilton, as his address.

Aitken, J., '11. We do not know his address.

Akers, H. G., '08, is a member of the firm of Akers, Mason & Bonnington, chemical engineers, Confederation Life Building, Toronto.

Alexander, J. H., '04. His address is not known.

Alison, T. H., '92, is with the Bergen Point Iron Works, Bayonne, N.J., as chief engineer and secretary of the firm.

Alison, J. G. R., '03. His address is 50 Murray St., Toronto. He has recently been engaged in engineering work at Lorne Park, Ont.

Allan, J. R., '92, is in Renfrew, Ont., carrying on a general engineering and surveying practice.

Allan, J. L., '00, is in Dartmouth, N.S., on Government service, as office engineer on the construction of a branch line from Dartmouth to Dean, N.S.

Allan, L. B., '11 is in the Roadways Department, City Hall, Toronto.

Allan, L. F., '08. His address is 362 Dupont St., Toronto.

Allen, F. G., '07. We do not know his present address.

Allen, R. J., '13, is demonstrator in electrical engineering at the University of Toronto.

Allison, C. B., '08, is engaged in Dominion and Ontario land surveying. His address is South Woodslee, Ont.

Alport, F., '08, is with the 5th Field Company, Canadian Engineers, 2nd Canadian Contingent, at Ottawa.

Alton, J. L., '14. His home address is Lucknow, Ont.

Amos, W. L., '06, is in the engineering department of the Hydro Electric Power Commission, Toronto.

Amsden, W. G , '10, is with the Consolidated Optical Co., Toronto.

Anderson, A. G., '92, is a hardware merchant at Port Dover, Ont.

Anderson, A. S., '13. His home address is 455 Hunter St., Peterboro, Ont.

Anderson, F. J., '07, is at Niagara Falls, Ont., with Anderson & Barry, engineers and surveyors.

Anderson, R. M., '08, is a member of the firm of Speight & Van Nostrand, engineers and surveyors, Toronto.

Andrewes, E., '97, is business manager for the Maenofferen Slate Quarry Co., of Portmadoc, North Wales.

Angus, H. H., '03, is on the staff of the Canadian Domestic Engineering Co., Toronto.

Angus, R. W., '94, is Professor of Mechanical Engineering, University of Toronto.

Apsey, J. F., '88, has a practice as civil engineer in Baltimore, Md. His address is 3 N. Calvert St.

Archer, E. G., '11, is in the estimating department of the Hydro Electric Power Commission, Toronto.

Ardagh, A. G., '93, has a private practice in Barrie, Ont., land surveying and engineering.

Ardagh, E. G. R., '00, is assistant Professor of Chemistry, University of Toronto.

Arens, A. H., '06, is resident engineer and mine surveyor for the Inverness (N.S.) Railway & Coal Co.

Arens, E. G., '09, is with the Calgary Iron Works, Calgary, Alta.

Arens, H.W., '03, deceased.

Arens, R. J., '08, is assistant superintendent of the Firestone Tire & Rubber Co., at Akron, Ohio.

Armer, J. C., '06, is manager of the *Canadian Manufacturer* Publishing Co., and secretary-treasurer of the Commercial Press, Limited, Toronto.

Armour, R. H., '05. His present address is not known.

Armstrong, H. V., '09, is town engineer, Estevan, Sask.

Armstrong, J., '95, is chief engineer for the Hudson Bay Railway. His headquarters are at Le Pas, Man.

Ashbridge, W. T., '88, of the Ashbridge Brick Co., 1444 Queen St. W., Toronto, lives at 195 Silver Beach Ave.

Augustine, A. P., '07, is in Vancouver, B.C., and is engaged in land surveying.

Austin, E. T., '09, is in the employ of the Mond Nickel Co., at Coniston, Ont., as superintendent.

Avery, C. R., '13, is on the staff of the Provincial Board of Health at the experimental station on Clifford St., Toronto.

Aylesworth, C. B., '05, is with the Canadian Westinghouse Co. at Hamilton.

B

Badgley, L. A., '11, is a demonstrator in drawing, University of Toronto.

Bain, J. A., '00, is in Ottawa, as structural engineer, Department of Public Works.

Bain, J. W., '96, is Associate Professor of Applied Chemistry, University of Toronto.

Baird, J. A. '10, is in practice in surveying and general engineering, Leamington, Ont.

Baird, W. J., '10, is with No. 2 Company, Divisional Train, 1st Canadian Contingent, Salisbury Plain, England.

Baker, M. H., '06, is city engineer for Prince Albert, Sask.

Baldwin, F. W., '06, is engaged with Graham Bell, Esq., Hammondsport, N.Y., and Baddeck, N.S., in experimentation and manufacture of aeroplanes.

Baldwin, L. C. M., '13. His address is Forest Hill Rd., Toronto. He is now in active service in France.

Ball, E. F., '88, is chief assistant engineer of resurveys, N.Y.C. & H.R. R.R. Co., New York city. His address is 335 Warburton Ave., Yonkers, N.Y.

Ballantyne, H. F., '93, is in New York, where he has for some years been carrying on an architectural practice at 2 West 47th Street.

Banks, H. R., '14, is engaged in mining work at Gowganda, Ont.

Banting, E. W., '06, is a lecturer in surveying, University of Toronto.

Barber, Frank, '06, is engineer for York county, and is carrying on a consulting practice in bridge and concrete engineering at 57 Adelaide St. E., Toronto.

Barber, H. C., '08, is with The Standard Underground and Cable Co., Hamilton, Ont.

Barber, H. G., '02, is with the Department of the Interior, Topographical Surveys Branch, Ottawa.

Barber, T., '09, is hydraulic engineer for Chas. Barber & Sons, manufac-

turers of turbine water wheels and accessories, Meaford, Ont.

Barber, W., '05, is with the city of Toronto, in the roadways department.

Barker, H. F., '94, is in the city. He is a member of the firm of Godson Paving Co.

Barley, J. H., '00, is in the engineering department, Canadian Westinghouse Co., Hamilton, Ont.

Barnett, H. A., '10, is with the Canada Pacific Railway Co., construction department, Toronto.

Barrett, J. H., '04, is with the Wm. Davies Co., Limited, Toronto, as superintendent.

Barry, W. H., '09, is a member of the firm Anderson & Barry, engineers and surveyors, Niagara Falls, Ont.

Bartlett, E., '08, is a member of the firm Bartlett & Grassie, engineers and surveyors, in Medicine Hat, Alta.

Bartley, T. H., '11. His address is 464 Gladstone Ave., Toronto.

Bates, M., '06, deceased.

Batten, H. L., '11, is engineer for the Consolidated Mining & Smelting Co. of Canada Ltd., Traill, B.C., at their Centre Star Mine, Rossland, B.C.

Beatty, F. R., '07, is assistant manager of the architectural bronze and iron department of the Canada Foundry Co., Toronto.

Beatty, F. W., '13. His home address is Pembroke, Ont. He had been engaged on D.L.S. work in Western Canada.

Beatty, H. E., '04. His address is Pembroke, Ont.

Beatty, H. J., '91, resides in Pembroke, Ont., as an engineer and surveyor.

Beatty, J. A., '03, is a member of the firm of Morrow & Beatty, contractors, Peterboro, Ont. They have been for some time engaged at Iroquois Falls, Ont., on the construction of the Abitibi Paper & Pulp plant.

Beatty, W. B., '13, is at Sarnia, Ont.

Beatty, W. G., '01. His last address on our fyle is Fergus, Ont.

Beauregard, A. T., '94, is at Darien, Conn., U.S.A.

Beckstedt, R. D. S., '09.

Bedford, F. J., '08. Deceased.

Bedard, E. L., '14. His home is at Lambton, Ont.

Bedard, H. J., '14. His home is at Lambton, Ont.

Begg, W. A., '05, is townsite inspector for the Department of Public Works, at Regina, Sask.

Beith, R. E., '09, is in the employ of the Department of Public Works, Sault Ste. Marie, Ont.

Belcher, J. T., '14. His home address is at 536 Clendenan Ave., Toronto.

Bell, C. A., '13, is sergeant with the Canadian Engineers, 1st Contingent, at Salisbury Plain, Eng.

Bell, G. G., '05. We do not know his present address.

Bell, R. S., '13. His address is 10 Starr Ave., Toronto.

Bennett, G. A., '09. His last address on our file is Tillsonburg, Ont.

Bennett, S. G., '14, is engaged in active service with the British Army at Rouen, France. He had, previous to Dec. 1st, 1914, been taking a course at Oxford University.

Bergey, A. E., '94, is associate professor of constructive design in the Carnegie Institute of Technology, at Pittsburgh, Pa.

Berkeley, G. L., '11, is assistant engineer in the Surveys Department for the Toronto Harbor Commission.

Berry, E. W., '10, is on Dominion land survey work, Department of the Interior, Ottawa. He is a D.L.S. man.

Bertram, G. M., '01, is manager of the Joplin, Mo., branch of the Sullivan Machinery Co., manufacturers of mining and quarrying equipment.

Betts, H. H., '06, is in Rio de Janeiro, Brazil, for the Rio de Janeiro Tramway, Light & Power Co.

Beynon, D. E., '06, is general superintendent of the Dunlop Tire & Rubber Goods Co., Toronto, as superintendent.

Billings, J. H., '11, is a candidate for Master's degree at Massachusetts Institute of Technology, Boston, Mass., where he is taking a special course in mechanical engineering.

Bingham, H. C., '10, is engineer and land surveyor, New Grayson Bldg., Moose Jaw, Sask.

Binns, R. E., '13. His address is not on our fyle.

Birchard, E. R., '09, is with the second contingent at Exhibition Park as sergeant-major with the Eaton battery.

Bissett, D. C., '10, is engineer for the Dome Mines, Porcupine, Ont.

Bissett, G. W., '06, is mill superintendent for the Canadian Exploration Co., Limited, at Naughton, Ont.

Bissett, J. R., '11, is in the Water Power Branch of the Department of the Interior, Ottawa.